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WHEN IS A SCHOOL ENVIRONMENT PERCEIVED AS SUPPORTIVE BY BEGINNING MATHEMATICS TEACHERS? EFFECTS OF LEADERSHIP, TRUST, AUTONOMY AND APPRAISAL ON TEACHING QUALITY

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ABSTRACT. This study examines the hypothesis that the more support beginning mathematics teachers perceive and the better they evaluate the management of their school, the higher their teaching quality is. Indicators of teaching quality were how the teachers, who were in their third year in the profession, regarded themselves able to cope with the challenges of mathematics instruction and generic tasks like classroom management and how satisfied they were with their job. Indicators of support were the level of appraisal and autonomy the teachers reported. School management indicators were the administrative leadership of the principal and the climate of trust as perceived by the teachers. Our results reveal that teacher support plays an important role in the quality of beginning mathematics teachers. All quality indicators improved significantly if beginning teachers reported more appraisal and autonomy. A climate of trust plays an important role for the extent of autonomy perceived. Administrative leadership was significantly related to the amount of appraisal the teachers reported. Our results provide important information on how to steer a school so that the quality of beginning mathematics teachers is maximized.

KEY WORDS: administrative leadership, beginning teachers, job satisfaction, mathematics instruction, school climate, structural equation modelling, teacher appraisal, teacher autonomy, trust in the principal

Introduction

The "Teacher Education and Development Study in Mathematics (TEDS-M; Tatto, Schwille, Senk, Rodriguez, Bankov Reckase et al., 2012)" closed a serious research gap by measuring the effects of opportunities to learn during teacher education on the quality of mathematics teachers (Blömeke, Suhl & Kaiser, 2011, 2012a, b). At the same time, the "Teaching and Learning International Survey (TALIS; OECD, 2010)" closed another research gap by examining how practicing teachers perceive their school environment and its effects on their teaching quality.

However, the induction period as a sensitive period in a teacher's life (Paine, Pimm, Britton, Raizen & Wilson, 2003), i.e. the first 3–5 years as beginning teachers, was left out by both studies. The present paper closes this research gap by examining how 221 middle school mathematics teachers

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from Germany, who were in their third year in the profession, reported about their teaching quality in relationship to the quality of their school environment and the extent of support they received.

Significance of the Study

The first years in the teaching profession are regarded as being decisive for further professional development (Feiman-Nemser & Parker, 1993; Veenman, 1984). Beginning teachers have to cope with an almost overwhelming task: applying the knowledge gained during teacher education to different and complex classroom situations with multidimensional challenges occurring at high speed (Sabers, Cushing & Berliner, 1991). Developing teaching quality during these first years is therefore an important task for all education systems. Evidence suggests that the quality of the school environment is important at this stage of a teaching career (Darling-Hammond & McLaughlin, 1995). However, it is widely unknown which characteristics of the school environment are relevant and how they are related to different indicators of teaching quality.

Based on models from occupational psychology and using well-established scales from TALIS and the OERI (Office of Educational Research and Improvement at the US Department of Education) teacher studies, this paper examines the relationship of administrative leadership, school climate, teacher autonomy and teacher appraisal to teaching quality. How beginning middle school mathematics teachers perceive themselves able to cope with the challenges of a mathematics classroom and how satisfied they are with what they are doing are used as indicators of their self-reported teaching quality. Our results thus provide information on how to steer a school so that the quality of beginning mathematics teachers is maximized. Many education systems are in urgent need of improving their mathematics education in order to meet the challenges of global competitiveness (Ingersoll, 2001).

Conceptual Framework and Hypotheses

The Criteria: Self-Reported Indicators of Teaching Quality

Our definition of teaching quality is based on the notion of professional competence as developed by Weinert (2001) and Bromme (1997). Competence in this tradition means to have the dispositions to successfully solve the core tasks of a teacher. The tasks to be dealt with by middle school mathematics teachers are defined in state and professional standards (see, e.g. NCTM, 2000) and confirmed in empirical studies on predictors of

student achievement (Brophy, 1999; Wang, Haertel & Walberg, 1993). According to these papers, middle school mathematics teachers have to master the instructional challenges of a diverse mathematics classroom. These include lesson preparation, the development of mathematical problems and diagnosing student progress. In addition, generic tasks are to be mastered. These include classroom management, student motivation and cooperation with parents. How beginning teachers perceive themselves as being able to cope with these challenges is an important quality indicator.

Research from occupational psychology reveals in addition that for long-term excellence, it is important to be satisfied with one's work (Lubinski & Benbow, 2000; Judge, Bono, Erez & Locke, 2005). Evidence suggests that teachers' perceived job satisfaction significantly influences their behavior in the classroom (Toh, Ho, Riley & Hoh, 2006; Watt & Richardson, 2008). If teachers are satisfied with their job, not only is their organizational commitment higher but also their students' achievement levels (Bogler, 2002). In contrast, if teachers perceive their job as a burden, the risk of an early burnout increases (Schaarschmidt & Fischer, 2001). Job dissatisfaction then appears together with a negative development in student achievement (Helmke, Hosenfeld & Schrader, 2002). Teacher dissatisfaction contributes to a proportion of teachers leaving the profession, as well (Ingersoll, 2001).

We hypothesize that the three indicators of teaching quality are positively correlated with each other because, according to Csikszentmihalyi (1990), individuals reach a state of satisfaction when they experience a high level of strength at work, in this case when they are best able to utilize their abilities to cope with mathematics instruction and classroom management.

Predictors: Support of the Beginning Teachers and School Management

Occupational research indicates that autonomy and appraisal are two important features of support that affect work quality (Shen, Leslie, Spybrook & Ma, 2012). Hackman & Oldham (1980) collected evidence on this with respect to different jobs. Besides task significance and the employee's skills, the perceived autonomy and the perceived feedback were the strongest predictors of work quality. The mastery of job-related challenges and job satisfaction are particularly high if people can follow their interests (Lubinski & Benbow, 2000). Their willingness to strive is then higher and lasts longer (Swanson & Fouad, 1999).

Teacher-related research suggests a similar relationship. A climate of respect, recognition and appreciation significantly contributes to how teachers report about the quality of their work, especially in terms of job satisfaction (Kouzes & Posner, 1999; Shen et al., 2012). The TALIS results support the positive effects

of teacher appraisal as well (OECD, 2009). Teachers not only consider appraisal as a fair assessment of their work but also that it has a positive influence on their satisfaction, the quality of their work and their development as teachers. Support through feedback is particularly important for beginning teachers (Gimbert & Fultz, 2009). In addition, teachers report higher satisfaction and higher teaching quality when they have a sense of autonomy in terms of control over their classroom and participation in decisions at school (Perie & Baker, 1997; Shen et al., 2012).

The role of the principal seems to be particularly important in this context. They can set the tone of a school (Valentine, Clark, Hackmann & Petzko, 2004). To support their teachers, principals should provide high-quality management through administrative leadership, like clear communication on the one hand (Ma & MacMillan, 1999) and through empathy and a climate of trust on the other hand (Tschannen-Moran, Hoy & Hoy, 1998).

Clear communication means that principals have a vision for their school and that they are able to communicate it to the teachers whilst including their ideas. Trust is from an organizational perspective and involves a work group's generalized expectancy that they can rely on another individual, group or organization (Hoy & Kupersmith, 1985). Hoy, Tarter & Witkoskie (1992) and Tarter, Sabo & Hoy (1995) showed that how trustworthy teachers regard their school climate is significantly related to school effectiveness.

For our study, we hypothesize that the relationship between the broader, more distal school management characteristics and the more immediate indicators of teacher support is hierarchical (cf. Shen et al., 2012). Administrative leadership and a climate of trust are assumed to provide the context for the extent of autonomy and appraisal, which in turn are assumed to contribute to teaching quality. Appraisal and autonomy, which are in this sense regarded as a function of school management quality, sequentially influence the beginning teacher's ability to deal with the challenges of mathematics instruction and classroom management as well as their job satisfaction.

Research Purposes

Given the weak state of research on beginning teachers and the relationship of their teaching quality to different measures of support and school management, this paper focuses on two major research purposes:

1. First, instruments from TALIS and the US examining the relationship between perceived teaching quality, teacher support and school management are explored. Our objective is to confirm a measurement model that fits well with our sample of beginning mathematics teachers in Germany

and is also parsimonious at the same time. Thus, we intend to provide reliable and valid instruments to examine these constructs that can be used in further studies.

2. Second, we examine the structural relationship between our latent constructs. More specifically, we hypothesize a hierarchical relationship between the organizational characteristics of schools (administrative leadership and a climate of trust), directly perceived support of beginning mathematics teachers (autonomy and appraisal) and outcomes (teaching quality). This is an approach similar to TALIS where school variables were hypothesized to have effects on teacher variables, which in turn should result in certain teaching practices (OECD, 2009, p. 163ff; see also Shen et al., 2012).

Methods

Sampling

The sample consists of 221 German middle school mathematics teachers in their third year in the profession. These teachers had participated in TEDS-M in 2008 whilst they were in their final year of teacher education (Tatto, Schwille, Senk, Ingvarson, Peck & Rowley, 2008). A teacher education program was identified as preparing middle school teachers if the license included grade 8 as the common denominator of the education level 2 in the "International Standard Classification of Education" (UNESCO, 1997). In the following year, the sample made the transition into the profession after having taken an exit exam. Those teachers who had agreed to volunteer for further studies were followed up (TEDS-FU) via an online survey in the first half of 2011, i.e. whilst they were in their third year in the profession.

Table 1 reports the core characteristics of the TEDS-FU sample. Since we examine mathematics teachers, the proportion of males is relatively high compared to the full force of beginning teachers (KMK, 2003). The socioeconomic status (indicated by the number of books at home) and the ethnic background (indicated by the language spoken) correspond to the distribution of these characteristics as determined at the end of teacher education (Blömeke, Kaiser & Lehmann, 2010). About half of the beginning teachers were prepared for teaching mathematics only at middle schools, whereas the other half was prepared for teaching at middle and high schools.

TABLE 1

Characteristics of the TEDS-FU sample (proportion in per cent)

Gender (males)	41
Socioeconomic status (teachers with three or more bookcases at home)	53
Ethnic background (teachers always speaking the language of instruction)	95
Teacher education program (teachers prepared for middle and high schools)	53

We have to point out that the sample may have a self-selection bias in the sense that more teachers with a strong background in mathematics took part in TEDS-FU than in TEDS-M. TEDS-M participants were randomly selected, whereas TEDS-FU had to rely on voluntary participation. Thus, the sample has to be characterized as a convenience sample. We applied robust statistics to take the non-normality of the distribution into account.

Instruments

The ability to cope with the challenges connected to *mathematics instruction* was captured by four items covering typical tasks of beginning middle school mathematics teachers. Prompted by an initial question—"In the course of a year in the classroom, a teacher is expected to complete a diverse array of tasks. How easy was it for you to complete the following tasks?"—the items then had to be rated on four-point Likert scales ranging from "very difficult" to "very easy". Examples of items were "Knowing/ understanding math content" and "Planning math lessons".

The beginning teachers' ability to master more *generic teacher tasks* was captured by seven items. Prompted by an initial question—"What are some of the difficulties or challenges that you have encountered in your current teaching position?"—the statements had to be rated on three-point[1] Likert scales ranging from a "major problem" to "not a problem". Examples of items were "Classroom management/student behavior" and "Working with parents or guardians".

Several approaches exist to define *job satisfaction*. We selected a well-established approach by having the beginning teachers report their feelings (Oshagbemi, 1999). Such manifestations constitute an empirical definition of teacher satisfaction and have been proven to be effective indicators. They acknowledge that teachers commonly indicate job satisfaction in terms of feeling good when they are at work (Taylor & Tashakkori, 1995). Four items had to be rated on four-point Likert scales ranging from "strongly disagree"

to "strongly agree" after the initial request "Overall, my job is …". Examples of items were "enjoyable" and "fulfilling".

The beginning mathematics teachers' *autonomy* was measured by a scale used in studies like the NCES Schools and Staffing Survey or the OERI (1991) Teacher Survey (Cohan & Spillane, 1991; McLaughlin, Talbert & Phelan, 1990). Prompted by an initial question—"How much control do you feel you have in your classroom over each of the areas below?"—four items had to be rated on four-point Likert scales ranging from "none" to "a great deal". Examples of items were "Selecting content, topics and skills to be taught" and "Determining the amount of homework to assign".

The extent of *appraisal* was measured by identifying the frequency with which it occurred as undertaken in TALIS (OECD, 2010). Prompted by an initial question—"How often have you received appraisal and/or feedback from the following people about your work as a teacher?"—the beginning teachers had to rate three items that covered typical groups appraising mathematics teachers' work: the school principal, an external inspector or the teachers' colleagues. This had to be done on six-point Likert scales from "never" to "more than once a month". In contrast to TALIS where a binary index was created from the data, we were able to build a latent construct with the three indicators.

The quality of the *administrative leadership* was captured by five items prompted by an initial request: "Please indicate the extent to which you agree or disagree with each statement". The items from the OERI Teacher Survey had to be rated on four-point Likert scales ranging from "strongly disagree" to "strongly agree". Examples of items were: "The principal sets priorities, makes plans and sees that they are carried out" and "The principal knows what kind of school they want and have communicated it to the staff".

To what extent a *climate of trust* exists at a school was captured with three items and the same type of Likert scales from the OERI Teacher Survey. Following the same prompt, two item examples were: "This school's administration knows the problems faced by the staff" and "The school administration's behavior towards the staff is supportive and encouraging".

Data Collection

The TEDS-FU questionnaire was delivered online, as was done in TALIS. This was the only way to do the study in a feasible way given that the beginning teachers were distributed across the whole country with single teachers at each school. As an additional benefit, the online data collection reduced the costs of the survey and yielded a more accurate and timely available database (OECD, 2010). The TEDS-FU questionnaire could only

be filled out via the Internet. No other options were permissible, such as sending PDF documents via e-mail or printing out the questionnaire and mailing them. The process was operated in parallel for Germany, Taiwan and the USA by a private company in the USA.

Data Analysis

The research purposes were examined through structural equation modelling. Initially, the main latent constructs "teaching quality", "teacher support" and "school management" were validated; that is, the factors for each construct were explored in terms of their measurement properties by comparing models with the factor loadings fixed at 1, partly fixed at 1 and freely estimated in order to identify the best fitting and at the same time most parsimonious model, as recommended by Bollen (1989) or Raykov & Marcoulides (2006). If necessary and conceptually appropriate, the models were adjusted and then confirmed. Maximum likelihood parameter estimates with standard errors and a chi-square test statistic robust to non-normality were applied. Multiple linear regression standard errors were computed using a sandwich estimator.

The model fit was evaluated using a comparative fit index (CFI) and a global fit index (root mean square error of approximation, RMSEA). CFI estimates > .95 indicate a very good fit and estimates > .90 indicate a good model fit (Fan, Thompson & Wang, 1999; Hu & Bentler, 1999; Schermelleh-Engel & Moosbrugger, 2002). RMSEA estimates < .05 indicate a very good fit and estimates < .08 indicate a good model fit. All analyses were carried out using MPlus 5.1. Given the small sample size, one important objective of this first step was to achieve a parsimonious measurement model. Non-significant factor loadings, or insufficient proportions of variance explained, served as the criteria to examine the nature of the factors and to delete an indicator, if feasible, based on conceptual considerations.

In the next step, the structural relationship of the latent constructs was examined in a series of structural equation models. These tested different hypotheses on the relationship between school management, teacher support and teaching quality starting with a saturated model assuming significant correlations between all factors and then step-by-step eliminating non-significant relationships.

Limitations of TEDS-FU

Our data are based on self-reports from the teachers surveyed. Thus, they are not objective measures like the knowledge tests used in TEDS-M, but at risk of being biased by differences in the teachers' response styles or the different

expectations against which the items were rated. Still, the data represent the views of the teachers and give insight into how they perceive their situation as beginning middle school mathematics teachers. Another limitation is the cross-sectional nature of the data. The measures used in this paper were taken only once. Thus, we do not pretend to make causal claims, although we use the term "effects" when we describe the relationship between our variables (cf. OECD, 2010). Finally, the self-selection of the beginning teachers into the study may introduce bias. Since presumably teachers with higher achievement in mathematics were more willing to take part in TEDS-FU, we have to be careful with generalizations.

Results

A Profile of Beginning Middle School Mathematics Teachers in Germany

Table 2 describes how our sample perceived teaching quality, how much support the teachers had received and how they evaluated the management of their schools. Beginning middle school teachers rated their ability to cope with mathematics instruction and the extent of appraisal they have received slightly below the scale mean (2.5 or 3.5, respectively). On average, the beginning teachers received appraisal twice a year. All other characteristics were rated slightly or substantially above the respective scale means (classroom management = 2.0, or else 2.5).

Measuring Teaching Quality, Teacher Support and School Management

Teaching quality was captured by three factors with four mathematics instruction, seven generic teacher tasks and four job satisfaction items. With loadings freely estimated, the first and last scales fit well to the data. In contrast, the variance explained for the second scale's indicators was not in all cases significant, although they loaded significantly on the underlying factor. A closer look revealed that two items referred to the school context rather than to the classroom context. The model fit improved significantly once these items were removed.

In order to achieve a parsimonious model, all loadings were fixed to 1 in the next step. However, since the model fit dropped below the desired thresholds, the loadings of three items were freed again based on an examination of the amount of variance explained and the modification indices. In the case of job satisfaction, this applied to two items that described the job in a particularly enthusiastic way. In the case of mathematic instruction, this applied to the item that specifically referred to an understanding of mathematics content instead of

TABLE 2

Descriptive information for the scales examined

	Mean	*Standard error*	*Min–max*
Mathematics instruction	2.2	0.46	1.0–3.7
Classroom management	2.3	0.38	1.3–3.0
Job satisfaction	2.9	0.56	1.5–4.0
Teacher autonomy	3.2	0.57	1.3–4.0
Teacher appraisal	3.2	1.15	1.0–6.0
Administrative leadership	2.8	0.68	1.0–4.0
Trust in principal	3.0	0.72	1.0–4.0

teaching this content. Since the loading indicated a low but statistically significant correlation, we kept the item to inform scholars about the difference between mathematics content knowledge and mathematics pedagogical content knowledge, which is frequently discussed in the literature on teacher knowledge (Blömeke et al., 2011; Blömeke, Suhl & Döhrmann, 2013). The final model fit was good (CFI = .92, RMSEA = .05).

As hypothesized, the three factors correlated significantly positively. Job satisfaction was particularly strongly related to the teachers' self-reported ability to cope with generic tasks like classroom management. This result reflects the state of research well in that problems in this area mean a particular burden for teachers and increase the risk of an early burnout (Schaarschmidt & Fischer, 2001). Figure 1 documents the final measurement model of teaching quality (STDYX approach to standardize the parameters so that factor loadings can be interpreted as correlations: in the unstandardized solution, all but three loadings = 1.00).

Teacher support was captured by two factors with four autonomy and three appraisal items. With loadings freely estimated, both scales fit well to the data. The fit could significantly be increased by deleting one item that is in fact a problem in the German context. Whereas teachers may decide about the methods used in mathematics instruction or the homework given, they are limited in the selection of instructional objectives. These are set by the federal states.

Again, all loadings were then fixed to 1 to achieve a parsimonious model. The model fit dropped slightly. By freeing only one loading, it was possible to achieve an almost perfect model fit (CFI = 1.00, RMSEA = .00). The item that had to be freed was the one that rated the appraisal by external agencies in contrast to colleagues or the principal. In fact, external visits are a rare exception in Germany. Since the loading indicated a low but statistically significant correlation, we kept the item to inform scholars about the role of external visits, frequently discussed in the literature on beginning teachers' practices (Müller, Pietsch & Bos, 2011), as a measure of appraisal.

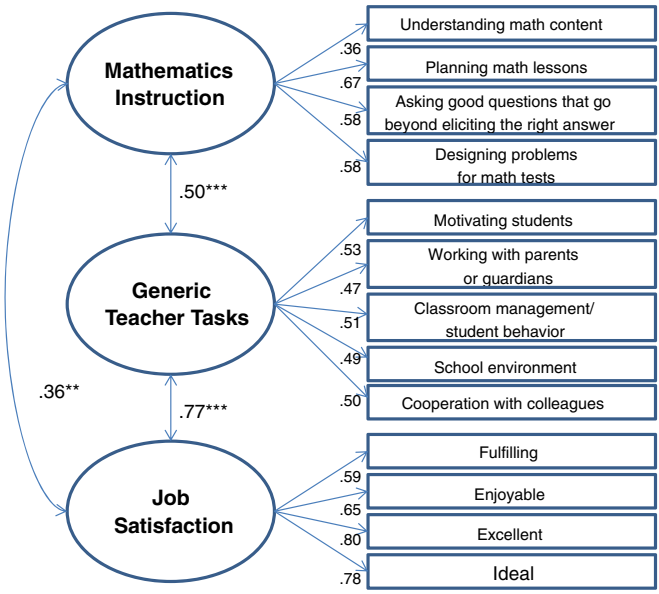

Figure 1. Measurement model of teaching quality (*rectangles*, items; *circles*, latent constructs)

As hypothesized, the two factors that describe how teachers were supported were correlated significantly positively, but in a modest way. Figure 2 documents the final measurement model of teacher support.

School management was captured by two factors with five administrative leadership and three climate of trust items. Although the loadings were freely estimated, and both the variance explained and the factor loading were significant in all cases, the model fit was inadequate for the data. Standard errors and modification indices pointed to problems with two items for the original leadership scale. Whereas three items captured effective communication and planning by the principal (like she "sets priorities" and "lets staff members know what is expected of them"), one item focused on the consequences ("makes the school run smoothly"). Since clear guidance, in fact, may sometimes result in conflicts, this item was deleted.

The other item caused problems because of a second loading on the trust scale. It reflects, in fact, more on how the teachers perceived that their ideas were taken up by the principal and therefore related more to the idea underlying the climate of trust scale. The item was therefore moved from the leadership to the trust scale. The overall fit was then good.

The model fit was still good when all the loadings were fixed to 1, but improved by freeing the load of the item which moved from one scale to the other (CFI = .94, RMSEA = .08). As hypothesized, the two factors were

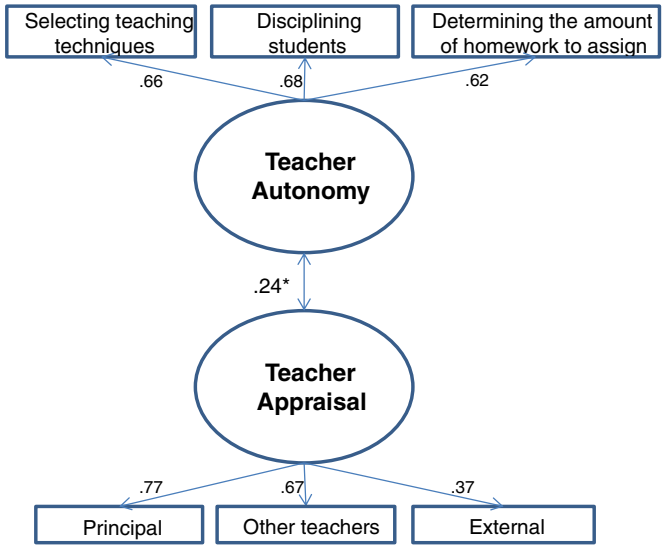

Figure 2. Measurement model of teacher support

significantly positively correlated. Figure 3 documents the final measurement model of school management.

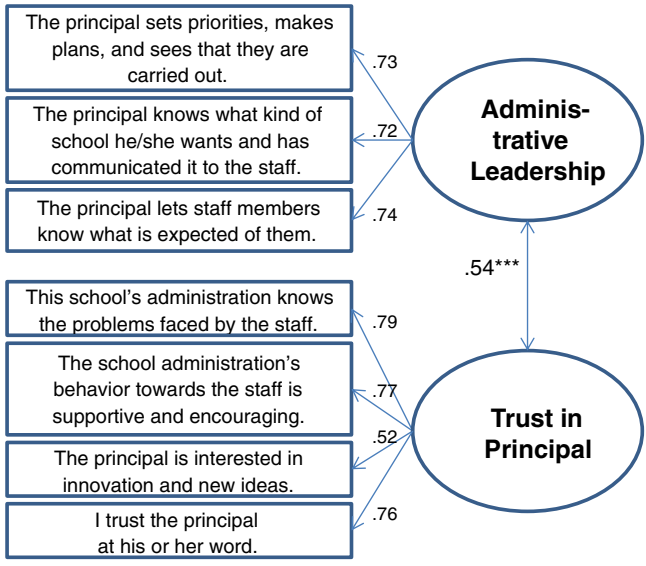

Figure 3. Measurement model of school management

Structural Relationship of School Management, Teacher Support and Teacher Quality

Following the TALIS models for practicing teachers (OECD, 2009, p. 165f), the relationship between school management, teacher support and teaching quality as perceived by middle school mathematics teachers in their third year in the profession was estimated as a hierarchical model assuming that the quality of school management significantly predicts the level of teacher support, which in turn significantly predicts teaching quality. Such a model showed in fact a good fit to our data (CFI = .92, RMSEA = .04). Two paths were not significant and were therefore removed without a drop in the model fit to achieve a parsimonious final model. Figure 4 shows the structural model with standardized estimates.

The relationship between school management and teacher support turned out to be different with respect to the different factors. Whereas the amount of autonomy reported by the teachers strongly depended on the climate of trust, but not on the leadership quality, the relationship was reversed with respect to the amount of appraisal reported by the teachers. This was higher if the leadership was perceived more strongly.

A strong relationship existed between teacher support and teaching quality. Each of the quality indicators depended significantly on each of the support

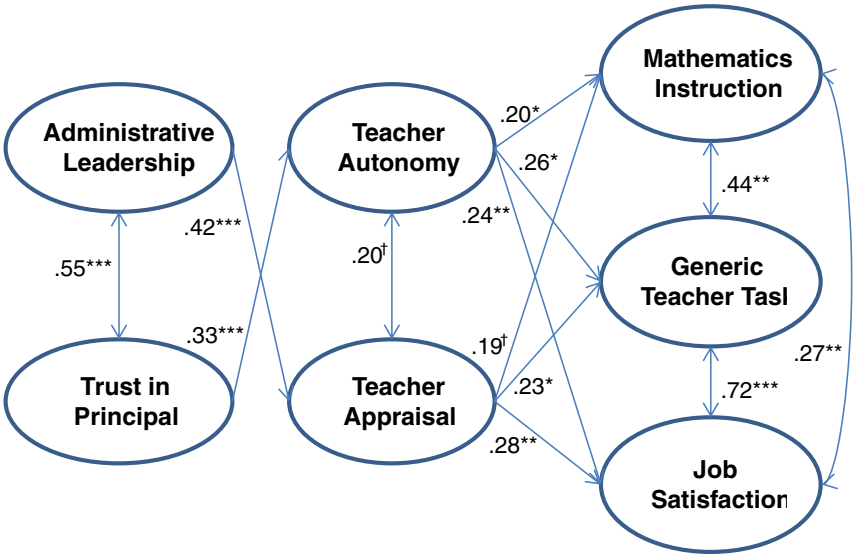

Figure 4. Relationship of school management, teacher support and teacher quality. ***$p < .001$; **$p < .01$; *$p < .05$; †$p < .10$

indicators. Frequent appraisal was of particular relevance with respect to job satisfaction. In contrast was the relevance of autonomy and appraisal, which was slightly lower with respect to the self-reported ability to cope with the challenges of mathematics instruction.

In order to verify the relationships, alternative models were tested that allowed for direct relationships between school management and teaching quality, but as expected, five out of six paths were not significant. The only exception was the relationship between a climate of trust and generic teacher tasks like classroom management.

Summary and Discussion

In this small-scale study, we examined the effects of school management and teacher support on teaching quality in Germany as perceived by middle school mathematics teachers in their third year in the profession. Based on models from occupational psychology, teaching quality was measured with self-reports not only as to what extent the teachers perceived themselves as being able to cope with core job-related tasks but also how satisfied they were with their job.

We used well-established scales from TALIS (OECD, 2010) and the OERI (1991) teacher studies in order to predict beginning mathematics teachers' teaching quality. The measurement properties of these scales were in general appropriate for our German sample. A closer examination revealed in a few cases that, due to national peculiarities, single items of the OERI scales were not perfectly in line with the latent constructs to be captured. We removed the items in these cases. In this way, and by fixing most of the item loadings, we were able to achieve three parsimonious measurement models that could be applied to our German sample with a good model fit.

From the descriptive information, we learned that the perceived level of teaching quality pointed to difficulties with mathematics instruction, whereas coping with the challenges of classroom management and the beginning teachers' job satisfaction were rated positively. The support by the school principal and the quality of school management were rated positively as well. Thus, the situation of the beginning teachers in our sample only raises concern with respect to their lack of mathematics affiliation. Mathematics instruction is a crucial task of a mathematics teacher though. Taking additionally into account that the German sample—due to its nature as a convenience sample with voluntary participation—was probably biased towards teachers who are stronger in mathematics than teachers who did not take part in the survey, the extent of the problems appears to be serious. This result supports the alarming conclusions drawn from TEDS-M (Blömeke et al., 2011, 2012).

Our structural model of the school environment, teacher support and teaching quality that claimed a hierarchical relationship for these constructs showed a good fit to our data, in particular taking its complexity and the small sample size into account. The model is even more supported by the fact that a model that allowed for direct effects of school management on teaching quality (with one exception) did not show significant paths. Summarizing the effect sizes, we can point out that the extent of teacher support depended on the quality of the school management and was, in turn, an important predictor of the teaching quality of beginning middle school mathematics teachers in Germany.

All indicators of teaching quality improved if the teachers perceived more autonomy and more frequent appraisal. Thus, the culture of middle schools seems to be greatly characterized by high importance of interpersonal relationships. Frequent appraisal was of particular relevance with respect to job satisfaction, which fits well to our theoretical framework. That the relevance of autonomy and appraisal was lower with respect to the self-reported ability to cope with the challenges of mathematics instruction is a convincing result, in particular given that, here, factors like content knowledge and pedagogical content knowledge may be more important.

The amount of autonomy reported by the teachers depended on the climate of trust, but not on the leadership quality, which reflects, in fact, plausible relationships. If a principal sets priorities and communicates these clearly, the teachers report more appraisal. In contrast, the degree of autonomy teachers receive depends on how trustworthy they perceive the school climate. It was also convincing that the amount of appraisal reported by the teachers was higher if the leadership was perceived more strongly.

With our results, we were able to replicate the results from TALIS (OECD, 2009). We could confirm that the relationship between school management, teacher support and teaching quality as perceived by middle school mathematics teachers in their third year in the profession is hierarchical. At the same time, we provided evidence that also in the teaching profession, autonomy and appraisal are highly relevant for the quality of work, as stated in occupational research in general (Shen et al., 2012; Hackman & Oldham, 1980). The school context is an important precondition for the characteristics of the classroom context, and this is an important precondition for teaching quality (Ma & MacMillan, 1999; Tschannen-Moran et al., 1998).

Conclusions

Developing beginning teachers' competencies is crucial for all education systems given that they have to cope with many different and almost

overwhelming challenges at the same time (Sabers et al., 1991). We have to be careful with inferences from this cross-sectional study which was based on a small sample that, in addition, relied on self-reports. However, our results correspond widely with the TALIS results, and they specify these for a population that has not yet been examined: beginning middle school mathematics teachers in Germany. Thus, they allow for tentative conclusions that are worth further investigation.

Our data reveal that principals should provide high-quality management through administrative leadership like clear communication (Ma & MacMillan, 1999) and a climate of trust (Tschannen-Moran et al., 1998) if they want to support their teachers. This support in terms of autonomy and appraisal is then of direct relevance for teaching quality.

With respect to our indicators of teacher quality, it seems as if generic teacher tasks like classroom management play a crucial role for job satisfaction. This result replicates the findings by Lipowsky, Thußbas, Klieme, Reusser & Pauli (2003) who had, based on data from a German–Swiss video study, pointed out that German mathematics teachers have to create a peaceful learning environment before they can start the teaching of mathematics. Recent models of teacher education in Germany may underestimate the importance of such generic tasks. This conclusion is supported by the low amount of opportunities to learn classroom management and work with parents reported in TEDS-M by mathematics teachers at the end of their training (Blömeke et al., 2010).

The importance of appraisal and trust points to the value of creating a cooperative working environment where teachers have many opportunities to talk and supervise each other. This can happen not only by giving them extra time for such activities but also by providing work space, which is rare in German schools. Especially with respect to middle school teachers, it may be a good idea to install an induction period in which they receive extra support with respect to the specifics of their school environment.

Principals have a crucial role in all respects if the quality of a school's environment is to be improved. However, Germany does not have training for principals yet. To a large extent, highly qualified teachers are selected for this job—although it is questionable whether these two groups of school personnel dispose of the same type of qualification given the differences in their tasks. It can reasonably be assumed that a systematic preparation of principals towards characteristics as pointed out in this study would improve school quality in the long run.

ACKNOWLEDGMENTS

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NOTE

[1] Using Likert scales with different ranges is not a problem in SEM.

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